

Low back pain in China and the role of traditional Chinese medicine: findings from the global burden of disease study 2021 and a meta-analysis

Man-ci Zhou^{1,2}, Xiu-mei Wang³, Jun-yan Zeng⁴, Guo-lin Guo⁵, Mitchell Levine⁶, Jian Li⁷, Hong-guo Rong^{1,5,✉}

¹Institute for Excellence in Evidence-Based Chinese Medicine, Beijing University of Chinese Medicine, 100029, Beijing, China

²Vanke School of Public Health, Tsinghua University, 100084, Beijing, China

³School of Humanities, Beijing University of Chinese Medicine, 100029, Beijing, China

⁴School of Health Policy and Management, Chinese Academy of Medical Sciences & Peking Union Medical College, 100730, Beijing, China

⁵Center for Evidence-Based Chinese Medicine, Beijing University of Chinese Medicine, 100029, Beijing, China

⁶Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, L8S 4K1, Canada

⁷General Outpatient Department, Beijing University of Chinese Medicine Third Affiliated Hospital, Beijing, 100029, China

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ABSTRACT

Introduction To quantify the burden of low back pain (LBP) and its risk factors in China from 1990 to 2021 and to assess the efficacy of traditional Chinese medicine (TCM) interventions. **Methods** The incidence, prevalence, and years lived with disability (YLDs) of LBP in China were searched. Trends from 1990 to 2021 were assessed using estimated annual percentage changes, stratified by age and sex, and joinpoint regression evaluated temporal patterns in LBP burden attributable to risk factors. Then, we searched ten electronic databases (up to April 2025) for randomized controlled trials (RCTs) of TCM interventions. The primary outcomes were pain intensity and physical function. **Results** In 2021, China had the highest absolute incidence, prevalence, and YLDs of LBP among G20 countries, although its age-standardized YLD rate had decreased significantly since 1990. An estimated 3.31 million YLDs (95% UI: 2.28, 4.53) were attributable to occupational ergonomic factors, 1.85 million (95% UI: 1.08, 2.70) to smoking, and 1.06 million (95% UI: 0.11, 2.23) to high body mass index. The systematic review identified 137 eligible trials involving 11 936 participants. Moderate-confidence evidence showed reduced post-intervention pain intensity with acupuncture plus physiotherapy care (standardized mean difference [SMD] = -1.59, 95% CI [-2.10, -1.09]), acupressure (SMD = -0.87, [-1.17, -0.57]), and acupuncture plus moxibustion (SMD = -2.44, [-2.72, -2.16]) versus physiotherapy care. Improved physical function had moderate-to-very-low confidence with acupuncture (SMD = -1.50, [-2.44, -0.57]) and Tai Chi (SMD = -1.84 [-2.30, -1.37]) compared with physiotherapy care and Western medicine. **Conclusion** Despite the decline in age-standardized YLD rates since 1990, the absolute burden remains substantial. Incorporating TCM into management may help address this burden but requires risk-stratified, large-scale, high-quality RCTs with extended follow-up.

Registration: The study protocol was registered with the International Prospective Register of Systematic Reviews (<https://www.crd.york.ac.uk/PROSPERO/>, CRD420251054137).

KEYWORDS

low back pain, traditional Chinese medicine, global burden of disease study, China

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1. Introduction

Low back pain (LBP), characterized by non-specific discomfort between the lower ribs and gluteal folds with or without sciatica, poses a major global health challenge. According to the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021, LBP has emerged as the leading cause of disability worldwide, affecting 619 million individuals in 2020.¹ In China, LBP is also a major public health concern, impacting 91.3 million people and resulting in 8.6 million years lived with disability (YLDs) in 2019.² Although most acute LBP improves within the first month or six weeks,^{3,4} residual mild-to-moderate pain and disability can persist, impairing quality of life, work capacity, and daily activities.^{5,6}

Over the past three decades, key recommendations for treating LBP have shifted. Overuse of medications, surgery, and lumbar imaging has raised concerns over associated risks, wasted healthcare resources, opioid addiction, and

postoperative complications.⁷ Hence, national clinical practice guidelines increasingly emphasize self-management, physical and psychological therapies, and complementary medicine over pharmacological or surgical interventions.⁸⁻¹⁰ Traditional Chinese medicine (TCM) offers a distinct therapeutic paradigm, including Chinese herbal medicine, acupuncture, moxibustion, cupping, and tuina. In 2019, the National Administration of TCM in China issued a circular implementing TCM clinical pathways and treatment protocols, officially identifying LBP as a disease predominantly managed through TCM. Previous studies indicate that TCM may benefit LBP management while easing the financial burden on patients, families, and society.¹¹⁻¹³ Hence, evaluating the efficacy and safety of TCM interventions against GBD-defined burden and risk factors may facilitate their integration into guideline recommendations and help clinicians and patients make more informed decisions.

Although TCM is endorsed for treating LBP, recommendations for its application remain inconsistent.¹⁴ A 2015 review of seven randomized controlled trials (RCTs) found preliminary evidence supporting acupuncture, acupressure, and cupping for LBP, while highlighting the need for further research on Tai Chi, tuina, and moxibustion.¹⁵ Another review of 11 RCTs found that cupping reduced pain more substantially and durably than both medication and standard care.¹⁶ Yet these reviews addressed only a limited

✉ Corresponding author.

E-mail address: hgrong@hsc.pku.edu.cn (HG. Rong)

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subset of TCM interventions and did not focus on the Chinese population. Several studies have used GBD data to characterize LBP burden in China: Xu analyzed provincial prevalence and YLDs from GBD 2019, while more recent GBD 2021 analyses examined national age-standardized trends or a single risk factor such as high body mass index (BMI).^{2,17} Although these studies advanced understanding of LBP epidemiology in China, none has comprehensively evaluated TCM's capacity to mitigate the GBD-identified risk factors, and existing studies are constrained by occupational or geographic limitations that fail to capture national risk patterns.^{18,19} We integrated GBD 2021 data to evaluate the prevalence, incidence, and YLDs of LBP and its risk factors in China. Using a systematic review and meta-analysis framework, we then investigated the effectiveness of TCM interventions in mitigating these risk factors and relieving LBP. We hypothesized that TCM may reduce LBP-related risk factors, though efficacy may vary across subtypes. Our overarching goal was to inform government and health policymakers and highlight the role of TCM in LBP management.

2. Methods

This study comprises two parts united by a mechanistic rationale: the first identifies the modifiable drivers of LBP burden, and the second evaluates whether TCM can address them. First, we examined the burden of LBP in China using GBD 2021 data.²⁰ We estimated the incidence, prevalence, and YLDs of LBP and its risk factors in China, stratified by age and sex, from 1990 to 2021. Detailed GBD 2021 methodology is reported elsewhere.^{21,22} The GBD study complied with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement.²³ GBD 2021 identified three modifiable risk factors for LBP in China (occupational ergonomic exposure, smoking, and high BMI), each converging on a common endpoint: increased pain and impaired physical function.^{24–26} This convergence forms the mechanistic bridge between the two parts: because all three risk factors share these downstream manifestations, TCM interventions targeting the underlying pathways (e.g., improving local circulation and tissue repair, modulating inflammation, and enhancing core musculoskeletal strength) are directly relevant to the population-level burden identified in Part 1.^{27,28} Accordingly, the second part of the study employed a systematic review and meta-analysis of RCTs to assess the effects of TCM interventions on pain intensity, physical function, health-related quality of life, TCM syndrome scores, sleep quality, and adverse events in individuals with LBP. The study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA).²⁹

2.1. Disease burden of LBP in China: a systematic analysis of the GBD 2021

2.1.1. Case definition

LBP is defined as pain in the back area from the lower edge of the twelfth rib to the lower gluteal folds, occasionally radiating to one or both lower limbs, and lasting at least one day.¹ Cases of LBP are identified using specific codes from the International Classification of Diseases, Tenth Revision (ICD-10), which include M54.3 (sciatica), M54.4 (lumbago with sciatica), and M54.5 (low back pain).

2.1.2. Data source

In this part of the study, we extracted data on the incidence, prevalence, and YLDs of LBP from the GBD 2021 via the GBD Results Tool (<https://vizhub.healthdata.org/gbd-results/>, accessed February 15, 2025). For GBD 2021, LBP data were sourced primarily from electronic databases (PubMed, Ovid MEDLINE, Embase, and CINAHL), complemented by targeted searches, relevant government and international organization websites, published reports, demographic and health surveys, and GBD collaborator data, with no age, sex, or language restrictions. Search terms included “backache,” “lumbago,” “lumbar pain,” and “back pain,” in conjunction with terms such as “prevalence,” “incidence,” “cross-sectional,” and “epidemiology.”

Prevalence was estimated using a Bayesian meta-regression tool (DisMod-MR 2.1 [Institute of Health Metrics and Evaluation, Seattle, WA]) adjusting for age, sex, location, and year; the Meta-regression-Bayesian, Regularized, Trimmed (MR-BRT) network crosswalk method corrected for varying definitions, and data points with a median absolute deviation ≥ 1.5 above the mean were flagged as outliers. Further details are available elsewhere.^{1,22}

In GBD 2021, risk-factor exposure was analyzed using spatiotemporal Gaussian process regression or DisMod-MR 2.1.9 (Institute of Health Metrics and Evaluation, Seattle, WA) to generate relative-risk estimates for each risk-outcome pair. These were integrated with exposure data to calculate the population-attributable fraction for each pair, which was combined with incidence to determine disability-adjusted life-years, years of life lost, and YLDs. The LBP risk factors in GBD 2021 (occupational ergonomic exposure, smoking, and high BMI) were evaluated using published population data and representative sources.¹ The calculation process and definitions of these risk factors are detailed in previous studies.¹

2.1.3. Data analysis

The 2021 age-standardized incidence, prevalence, and YLD rates of LBP in China were extracted and compared with global averages and the G20 nations (an economic forum of 20 major economies; excluding the European Union leaves 19 individual countries). We also evaluated the 2021 burden by age and sex and analyzed sex-specific trends from 1990 to 2021. The estimated annual percentage change (EAPC) in age-standardized rates (ASR) was calculated to assess the average changing trends from 1990 to 2021. We hypothesized that the natural logarithm of ASR can be modeled using a linear regression framework expressed as $y = \alpha + \beta \times x + \varepsilon$, where y denotes the $\ln(\text{ASR})$, and x represents the calendar year; α is the intercept, β is the slope coefficient, and ε is the error term. Consequently, the EAPC with a 95% confidence interval (CI) was calculated as $\text{EAPC} = 100 \times (e^{\beta} - 1)$. An EAPC and 95% CI entirely above or below zero indicated a rising or falling trend; a 95% CI spanning zero indicated no significant change.

Joinpoint regression examined temporal trends in age-standardized YLD rates (ASyr) for LBP and its risk factors from 1990 to 2021, identifying significant change points in the time series ($P < 0.05$). The annual percent change (APC), with 95% CI, described trends over each interval, and the average annual percent change (AAPC) summarized the aggregate trend. An upward trend was identified when the AAPC and its lower 95% CI bound exceeded zero and a downward trend when the AAPC and both 95% CI bounds fell below zero. In this study, we used Joinpoint software (version 4.9.1.0, <https://surveillance.cancer.gov/joinpoint/>, accessed March 25, 2025) developed by the National Cancer Institute Division of Cancer Control & Population Sciences to determine the optimal number of joinpoints. The analyses were carried out with the R software package (version 4.4.1, www.r-project.org, accessed March 5, 2025).

2.2. Efficacy of TCM for LBP risk factors: a systematic review and meta-analysis

2.2.1. Search strategies

The second part of the study focused on a systematic literature search conducted from inception to April 2025 across ten electronic databases: PubMed, Scopus, Web of Science, Embase, CENTRAL (Cochrane Central Register of Controlled Trials), Cumulative Index to Nursing and Allied Health Literature (CINAHL), China National Knowledge Infrastructure (CNKI), Chinese Scientific Journal Database (VIP), SinoMed, and Wanfang databases. The following search terms were used: “low back pain,” “loin pain,” “low backache,” “lumbago,” “traditional Chinese medicine,” “herbal medicine,” “acupuncture,” “acupoint,” “qi gong,” and “Tai Chi” (Appendix 1).

2.2.2. Inclusion and exclusion criteria

• Participants

People aged 15 years or older residing in China with non-specific LBP of

any duration. We excluded LBP due to cancer, infection, inflammatory arthropathy, high-velocity trauma, fracture, or lumbar disc herniation, as well as LBP during pregnancy and cases with severe or progressive neurological deficits.

• Interventions

At least one evaluated modality had to be TCM. Both single-modality (e.g., acupuncture alone, tuina alone) and combined TCM interventions (e.g., acupuncture plus moxibustion, and Chinese herbal medicine plus physiotherapy care) were eligible. The specific treatments are listed in Appendix 2.

• Comparisons

The control group for this study comprised individuals receiving physiotherapy care, Western medicine (WM), advice interventions (AI), usual care (UC), no intervention (NI), and placebo control.

• Outcome measures

The primary outcome measures were the improvement in pain intensity and physical function. The secondary outcome measures were health-related quality of life (QoL), TCM syndrome scores, sleep quality, and the occurrence of adverse events. Pain intensity and physical function were selected as primary outcomes because they represent the shared clinical endpoint through which all three GBD-identified risk factors—occupational ergonomic exposure, smoking, and high BMI—ultimately manifest. Data pertaining to the outcomes of interest were collected at all follow-up time points. Follow-up (post-intervention) periods were: (I) immediately post-treatment; (II) short term follow-up (up to three months post-treatment); (III) intermediate follow-up (up to six months post-treatment); and (IV) long-term follow-up (over six months post-treatment).

• Study design

We included RCTs of patients with LBP in hospital, primary care, and home-care settings, published in Chinese or English.

2.2.3. Study selection and data extraction

Two reviewers (XMW and MCZ) screened titles/abstracts and full texts in two stages to identify eligible studies, resolving discrepancies by consensus. Two reviewers (XMW and JYZ) then independently extracted study characteristics and outcomes using a standardized electronic form, with disagreements settled by discussion and all data verified by a third reviewer (MCZ). For each study we extracted author, year, trial characteristics, patient details, intervention type, study duration, and outcomes.

2.2.4. Risk of bias assessment

Two reviewers (XMW and JYZ) independently assessed trial risk of bias using the updated Cochrane risk-of-bias 2.0 tool (University of Bristol, Bristol, United Kingdom).³⁰ The tool covers five domains: randomization, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results. Each study was rated “high risk,” “low risk,” or “some concerns” for bias, with disagreements resolved by a third reviewer (MCZ).

2.2.5. Data analysis

We compared between-group means and standard deviations for pain intensity and physical function at the end of treatment. Given that the included trials used heterogeneous outcome measurement instruments for pain intensity and physical function, standardized mean difference (SMD) with 95% confidence intervals was employed. Heterogeneity was assessed using the *I*² statistic, which was deemed significant heterogeneity if either $P < 0.05$ or $I^2 > 50\%$. If $I^2 < 50\%$, a fixed-effects model was selected to calculate the effect size. Otherwise, the data were pooled with the random-effects model to ensure model robustness of the analysis. Pairwise meta-analyses were performed for all direct comparisons with two or more studies. Random-effects models with inverse-variance weighting were used, and between-study heterogeneity was estimated using the DerSimonian-Laird method. Publication bias was evaluated using Egger's regression and funnel plots when a sufficient number of studies ($n \geq 10$) were included in the meta-analysis. Two authors (MCZ, XMW) applied the Grading of Recommendations Assess-

ment, Development, and Evaluation (GRADE) framework to assess the confidence levels in the evidence of each outcome, categorizing them as high, moderate, low, or very low.³¹ Sensitivity analyses were conducted post-intervention, involving the exclusion of high-risk-of-bias studies and studies published before 2010. Subgroup analyses were conducted based on meta-regression results, but only when two predefined criteria were met: (I) the meta-regression coefficient was statistically significant ($P < 0.05$), and (II) at least 10 studies were available for comparison. Subgroup analyses compared TCM effects by treatment duration: ≥ 4 weeks, 2–4 weeks, and < 2 weeks. All analyses were performed using R (version 4.4.1, www.r-project.org, accessed June 20, 2025), and the meta package was employed for the pairwise meta-analyses.³²

2.3. Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

3. Results

3.1. The trends in incidence, prevalence, and YLDs for LBP in China

In 2021, China reported the highest total incidence rate for LBP among the G20 countries, with 43.37 million cases (95% UI [37 494 376, 49 159 184]). However, the age-standardized incidence rate of LBP in China was the lowest, at 2342.46 per 100 000 (95% UI [2058.05, 2639.32]), which was below the global average of 3176.63 per 100 000 population (95% UI [2811.82, 3562.29]). The age-standardized incidence rate of LBP in China decreased by 18.08% (EAPC = -0.47% , 95% CI [-0.56 , -0.37]) from 1990 to 2021, the most significant decrease among the G20 countries. The prevalence of LBP in China was 100.09 million cases (95% UI [87 128 173, 113 014 316]), accounting for 15.92% of the global total. The decrease in the age-standardized prevalence of LBP in China since 1990 was 19.49% (EAPC = -0.50% , 95% CI [-0.60 , -0.39]), notably lower than that in the United Kingdom. In terms of YLDs rate, LBP caused 11.30 million (95% UI [7 931 468, 15 328 056]) cases of YLDs in China, the highest among the G20 countries, whereas the age-standardized YLDs rate generally showed a decreasing trend. In 2021, the age-standardized YLD rate of LBP was 603.03 per 100 000 population (95% UI: [427.63, 810.16]), representing a 19.49% decrease, with an EAPC of -0.49% (95% CI -0.60 , -0.39). According to EAPC, a decline in age-standardized incidence, prevalence, and YLDs rate of LBP was noted in the G20 countries, except for Brazil, Mexico, Saudi Arabia, and the United Kingdom (Figure 1).

New cases, prevalence, and YLDs of LBP in each group rose and then declined (Figure 2). In 1990, the burden of LBP was concentrated among individuals aged 35 to 50. By 2021, this age range shifted to 45 to 69, with the highest incidence occurring between 55 and 59 years old. From the 10–14 age group onward, LBP burden rose steadily with age. In both 1990 and 2021, the incidence, prevalence, and YLD rates of LBP in China were higher in females than in males, with the sex gap widening with increased age. The incidence, prevalence, and YLDs rate of LBP rose with age before decreasing, peaking in the 85–89 age group in 2021. After adjusting for population aging, the ASR of incidence, prevalence, and YLDs declined from 1990 to 1995 and then remained relatively stable (Appendix 3).

3.2. Risk factors affecting the YLDs for LBP in China

In 2021, YLDs due to LBP from all risk factors reached 5.22 million (95% UI [3.61, 7.14]), representing 46.2% of all YLDs associated with LBP (Table 1). 2.60 million (95% UI [1.79, 3.59]) YLDs in men and 2.62 million (95% UI [1.77, 3.68]) YLDs in women were attributed to risk factors for LBP. 3.31 million (95% UI [2.28, 4.53]) YLDs due to LBP were linked to occupational ergonomic factors, 1.85 million (95% UI [1.08, 2.70]) YLDs were associated with smoking, and high body mass index was responsible for 1.06 million

Country name	Incidence				Prevalence				YLDs rate			
	Number	ASR, per 100 000, 2021	percentage changes, %, 1990–2021	EAPC, %, 1990–2021	Number	ASR, per 100 000, 2021	percentage changes, %, 1990–2021	EAPC, %, 1990–2021	Number	ASR, per 100 000, 2021	percentage changes, %, 1990–2021	EAPC, %, 1990–2021
Argentina	2 083 325 (1 842 225, 2 339 082)	4121.75 (3641.43, 4371.71)	−1.22 (−17.87, 15.44)	−0.02 (−0.06, 0.02)	4 934 493 (4 365 734, 5 539 534)	9689.88 (8544.99, 10 208.85)	−0.98 (−17.71, 15.76)	−0.03 (−0.07, 0.01)	552 287 (391 178, 742 471)	1086.54 (770.80, 1368.32)	−1.26 (−44.52, 41.99)	−0.03* (−0.07, 0)
Australia	1 482 484 (1 308 569, 1 656 553)	4665.14 (4129.02, 5233.03)	−7.17 (−22.55, 8.21)	−0.16* (−0.19, −0.14)	3 632 185 (3 181 104, 4 053 379)	9111.25.08 (8151.98, 12 602.58)	−8.40 (−23.07, 6.28)	−0.21* (−0.24, −0.17)	404 050 (289 168, 547 269)	1255.82 (897.47, 1688.59)	−8.34 (−48.38, 31.69)	−0.21* (−0.24, −0.18)
Brazil	9 426 567 (8 304 552, 10 610 219)	3873.61 (3416.60, 4355.03)	2.08 (−15.32, 19.48)	0.04* (0.02, 0.06)	22 920 640 (19 975 535, 25 768 038)	9346.43 (8224.78, 10 501.25)	3.30 (−14.5, 21.1)	0.07* (0.04, 0.10)	2 539 065 (1 819 608, 3 418 673)	1034.16 (744.86, 1387.84)	3.17 (−41.51, 47.85)	0.08* (0.05, 0.10)
Canada	1 842 152 (1 614 666, 2 066 842)	3816.85 (3352.25, 4313.39)	−7.98 (−24.11, 0.15)	−0.18* (−0.21, −0.15)	4 333 536 (3 799 309, 4 839 311)	8808.10 (7775.51, 9920.89)	−8.44 (−24.00, 7.11)	−0.20* (−0.23, −0.17)	483 677 (344 637, 660 082)	990.93 (705.75, 1328.01)	−8.81 (−48.44, 30.83)	−0.21* (−0.24, −0.18)
China	43 374 995 (37 494 376, 49 159 184)	2342.46 (2058.05, 2626.87)	−18.08 (−32.24, 3.92)	−0.47* (−0.56, −0.37)	100 093 746 (87 128 173, 113 014 316)	5342.1 (4660.41, 5976.28)	−19.49 (−33.52, 4.54)	−0.50* (−0.6, −0.39)	11 297 805 (7931 468, 15 328 056)	603.03 (427.63, 810.16)	−19.49 (−55.21, 16.23)	−0.49* (−0.60, −0.39)
France	3 561 233 (3 151 402, 3 977 792)	4059.39 (3594.93, 4550.50)	−1.12 (−17.18, 14.9)	−0.04* (−0.05, −0.02)	8 606 897 (7 537 365, 9 566 141)	9567.67 (8423.92, 10 697.51)	−0.08 (−16.24, 16.09)	−0.02* (−0.04, 0)	951 532 (681 052, 1 270 497)	1071.05 (771.19, 1433.02)	−0.07 (−43.14, 43)	−0.02* (−0.04, 0)
Germany	5 280 955 (4 649 960, 5 946 989)	4479.42 (3974.85, 5045.12)	−4.92 (−21.11, 11.27)	−0.10* (−0.12, −0.08)	13 525 638 (11 953 401, 15 074 153)	11 089.56 (9825.79, 12 456.38)	−5.19 (−20.72, 10.34)	−0.10* (−0.13, −0.08)	1 497 385 (1 067 933, 2 000 007)	1242.99 (887.88, 1668.43)	−5.3 (−47.07, 36.46)	−0.11* (−0.13, −0.08)
Global	266 873 (235 369, 288 182)	3176.63 (2811.82, 3562.29)	−10.14 (−24.79, 4.51)	−0.29* (−0.32, −0.26)	628 838 475 (551 834 407, 700 881 341)	7463.13 (6575.68, 8321.8)	−11.06 (−25.57, 3.44)	−0.32* (−0.35, −0.28)	70 156 962 (50 194 205, 94 104 688)	832.18 (595.85, 1115.24)	−11.21 (−49.84, 27.41)	−0.32* (−0.35, −0.28)
India	38 580 905 (33 754 640, 43 316 909)	2816.31 (2476.17, 3169.09)	−12.72 (−27.43, 1.99)	−0.46* (−0.57, −0.35)	88 378 724 (76 690 994, 99 816 577)	6495.18 (5653.16, 7292.19)	−13.69 (−28.72, 1.33)	−0.5* (−0.62, −0.38)	9 780 012 (7 003 903, 13 127 349)	713.88 (509.42, 955.04)	−13.39 (−50.79, 24.01)	−0.48* (−0.6, −0.36)
Indonesia	7 461 578 (6 488 872, 8 462 645)	2637.47 (2322.71, 2969.76)	−2.88 (−19.29, 13.53)	−0.05* (−0.07, −0.03)	17 495 212 (15 170 534, 19 717 471)	6207.79 (5421.45, 6957.03)	−2.72 (−19.46, 14.02)	−0.04* (−0.06, −0.02)	1 985 798 (1 402 418, 2 680 164)	697.12 (496.56, 936.17)	−2.63 (−45.28, 40.03)	−0.03* (−0.05, −0.01)
Italy	3 554 242 (3 113 030, 3 997 678)	4105.26 (3609.92, 4634.55)	−1.38 (−18.14, 5.39)	−0.09* (−0.11, −0.08)	8 595 373 (7 523 229, 9 562 297)	9632.31 (8440.97, 10 814.43)	−1.03 (−18.03, 15.96)	−0.10* (−0.12, −0.08)	952 372 (674 066, 1 281 968)	1082.24 (773.35, 1455.86)	−0.61 (−43.81, 42.6)	−0.08* (−0.09, −0.06)
Japan	8 085 995 (7 116 421, 9 043 618)	4447.66 (3939.3, 5022.53)	−7.51 (−23.07, 8.05)	−0.18* (−0.21, −0.15)	20 008 724 (17 610 370, 22 194 703)	10 626.15 (9373.76, 11 935.56)	−8.20 (−23.36, 6.95)	−0.21* (−0.24, −0.18)	2 232 624 (1 590 996, 2 995 120)	1208.31 (861.08, 1627.71)	−8.00 (−48.3, 32.3)	−0.2* (−0.23, −0.17)
Mexico	4 148 822 (3 623 777, 4 709 984)	3076.45 (2698.66, 3487.05)	2.99 (−15.04, 21.02)	0.08 (−0.02, 0.17)	9 705 422 (8 453 488, 11 018 157)	7187.42 (6264.81, 8143.3)	2.99 (−15.58, 21.57)	0.08 (−0.03, 0.19)	1 085 530 (772 664, 1 462 111)	801.94 (572.56, 1081.9)	3.12 (−42.27, 48.52)	0.08 (−0.03, 0.19)
Republic of Korea	2 704 831 (2 366 623, 3 045 724)	3871.09 (3409.13, 4371.71)	−6.62 (−22.7, 9.46)	−0.18* (−0.21, −0.16)	6 450 707 (5 626 961, 7 267 718)	9025.43 (7908.34, 10 208.85)	−7.14 (−23.33, 9.06)	−0.22* (−0.24, −0.2)	727 108 (516 989, 977 658)	1020.94 (729.04, 1368.32)	−6.84 (−46.72, 33.05)	−0.21* (−0.23, −0.19)
Russian Federation	8 715 418 (7 611 600, 9 775 837)	4529.36 (4024.02, 5083.05)	−2.96 (−18.62, 12.7)	−0.02 (−0.05, 0)	21 356 309 (18 787 451, 23 691 942)	10 885.16 (9558.53, 12 109.4)	−3.77 (−19.31, 11.77)	−0.03* (−0.06, −0.01)	2 352 957 (1 685 540, 3 172 235)	1206.26 (866.68, 1623.31)	−3.85 (−45.76, 38.06)	−0.02 (−0.05, 0.01)
Saudi Arabia	1 305 265 (1 122 126, 1 526 171)	3508.43 (3089.91, 3964.15)	1.70 (−15.69, 19.1)	0.07* (0.06, 0.07)	3 046 049 (2 639 437, 3 517 216)	8183.71 (7179.18, 9185)	2.31 (−14.97, 19.59)	0.10* (0.09, 0.10)	344 324 (238 493, 460 839)	906.9 (645.76, 1204.63)	2.08 (−42.1, 46.27)	0.09* (0.08, 0.1)
South Africa	1 491 612 (1 302 877, 1 691 659)	2753.32 (2409.37, 3110.09)	−6.63 (−22.79, 9.53)	−0.19* (−0.21, −0.18)	3 413 489 (2 969 977, 3 842 766)	6348.57 (5524.91, 7134.81)	−7.35 (−23.55, 8.85)	−0.21* (−0.23, −0.19)	375 306 (268 811, 505 397)	693.42 (497.79, 927.6)	−8.59 (−48.2, 31.01)	−0.25* (−0.26, −0.23)
Türkiye	3 441 181 (2 993 295, 3 894 469)	3750.60 (3292.49, 4240.37)	−1.69 (−17.8, 14.41)	−0.01 (−0.06, 0.04)	8 183 785 (7 130 592, 9 147 088)	8879.73 (7790.75, 9931.43)	−2.06 (−16.8, 12.69)	0 (−0.07, 0.08)	915 900 (651 279, 1 235 554)	991.64 (708.1, 1330.33)	−2.51 (−44.18, 39.17)	0 (−0.08, 0.07)
United Kingdom	3 581 700 (3 160 238, 4 017 754)	4054.15 (3580.24, 4553.96)	0.46 (−16.27, 17.2)	0.16* (0.11, 0.21)	8 581 321 (7 522 462, 9 553 824)	9500.7 (8329.38, 10 674.23)	0.50 (−16.38, 17.38)	0.16* (0.10, 0.21)	951 935 (673 695, 1 278 999)	1062.95 (761.91, 1432.1)	0.04 (−43.41, 3.49)	0.15* (0.09, 0.2)
United States of America	18 681 080 (16 946 961, 20 396 397)	4501.63 (4092.82, 4911.62)	−5.72 (−19.4, 7.96)	−0.05 (−0.11, 0.01)	45 116 389 (42 173 149, 47 890 790)	10 670.05 (9968.49, 11 340.01)	−6.55 (−18.3, 5.20)	−0.06* (−0.12, 0)	4 940 706 (3 587 048, 6 412 519)	1179.08 (856.96, 1536.41)	−7.86 (−45.97, 30.24)	−0.1* (−0.16, −0.03)

Figure 1 Incidence, prevalence, and YLDs of LBP in 2021, with age-standardized (per 100 000 population) and their percentage changes and EAPCs from 1990 to 2021 for the 19 individual G20 countries (excluding the European Union) and the world

Notes: ASR: age-standardized rate; EAPC: estimated annual percentage change; LBP: low back pain; YLDs: years lived with disability. Colored cells indicate each region's rank (Rank 1, Ranks 2–5, Ranks 6–10, Ranks 11–15, Ranks 16–19, Rank 20) for: Number in 2021: Rank 1, Ranks 2–5, Ranks 6–10, Ranks 11–15, Ranks 16–19, Rank 20, with the 95% uncertainty interval in parentheses. ASR in 2021: Rank 1, Ranks 2–5, Ranks 6–10, Ranks 11–15, Ranks 16–19, Rank 20, with the 95% uncertainty interval in parentheses. Percentage changes from 1990 to 2021: Rank 1, Ranks 2–5, Ranks 6–10, Ranks 11–15, Ranks 16–19, Rank 20, with the 95% confidence interval (CI) in parentheses. 'Statistically significant, defined as the 95% CI for EAPC during this period excluding 0.

(95% UI [0.11, 2.23]) YLDs of LBP.

Between 1990 and 2021 in China, YLDs due to LBP influenced by all estimated risk factors, occupational ergonomic factors, and smoking increased by 30.12%, 4.60%, and 42.96%, respectively (Table 1). In contrast, the ASR of LBP in China exhibited a decline trend during this period, with an average annual percentage change (AAPC) of −1.00 (95% CI [−1.04, −0.96]) for all

estimated risk factors, −1.50 (95% CI [−1.60, −1.40]) for occupational ergonomic factors, and −1.18 (95% CI [−1.21, −1.15]) for smoking (Table 2). In contrast, the LBP burden from high BMI showed a clear upward trend. The most significant decline was observed from 1990 to 1994 across all estimated risk factors, occupational ergonomic factors, smoking, and high BMI. After 1994, there was a consistent increase in the ASR of LBP associated with

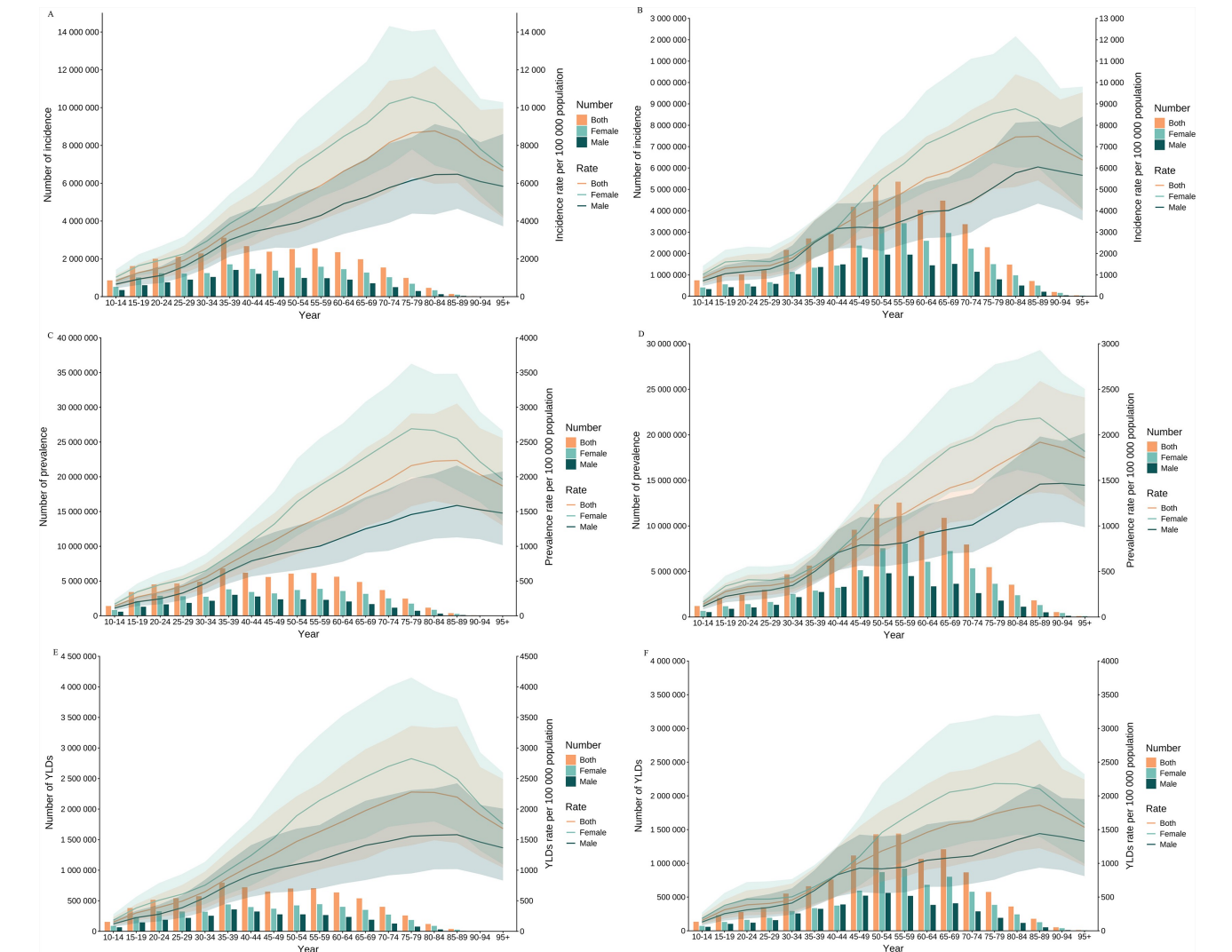


Figure 2 Incidence, prevalence, and YLDs of low back pain (counts and crude rates) by age and sex in China. Each panel shows the number and point rate of LBP by sex for: (A) incidence, 1990; (B) incidence, 2021; (C) prevalence, 1990; (D) prevalence, 2021; (E) YLDs, 1990; and (F) YLDs, 2021

Notes: YLDs: years lived with disability.

Table 1 YLDs and age-standardized YLD rates for LBP and its associated risk factors, in China and worldwide

Risk factors	China				Global			
	Numbers of YLD, 2021	Age-standardized rate per 100 000, number, 2021	Percentage change in number, 1990–2021 (%)	Percentage change in ASR, 1990–2021 (%)	Numbers of YLD, 2021	Age-standardized rate per 100 000, 2021	Percentage change in number, 1990–2021 (%)	Percentage change in ASR, 1990–2021 (%)
LBP attributable to all estimated risk factors								
Both	5 217 214.00 (3 613 106.77, 7 139 183.29)	271.29 (188.79, 371.86)	30.12 (−29.53, 89.77)	−27.31 (−60.28, 5.66)	27 867 943 (18 851 866.87, 39 135 824.18)	326.71 (221.51, 458.89)	57.42 (−18.66, 133.50)	−14.86 (−55.98, 26.26)
Female	2 617 213.70 (1 772 923.67, 3 683 493.69)	273.57 (188.31, 377.67)	28.50 (−34.04, 91.04)	−28.99 (−62.66, 4.68)	14 868 085.67 (9 650 763.3, 21 433 912.44)	344.07 (224.32, 494.39)	64.82 (−21.21, 150.84)	−11.06 (−57.20, 35.08)
Male	2 600 000.30 (1 792 835.89, 3 587 577.90)	270.01 (188.22, 368.54)	31.79 (−29.14, 92.73)	−25.74 (−59.11, 7.62)	12 999 857.33 (9 025 199.59, 17 865 483.81)	309.30 (214.89, 423.01)	49.74 (−19.87, 119.34)	−19.00 (−56.45, 18.46)
LBP attributable to occupational ergonomic factors								
Both	3 314 128.73 (2 275 895.54, 4 532 168.09)	178.44 (122.54, 243.59)	4.60 (−43.48, 52.68)	−37.45 (−66.28, −8.62)	15 569 218.82 (11 025 996.31, 20 908 968.38)	183.82 (129.49, 247.24)	43.47 (−19.89, 106.82)	−18.96 (−54.94, 17.02)

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Risk factors	China				Global			
	Numbers of YLD, 2021	Age-standardized rate per 100 000, 2021	Percentage change in number, 1990–2021 (%)	Percentage change in ASR, 1990–2021 (%)	Numbers of YLD, 2021	Age-standardized rate per 100 000, 2021	Percentage change in number, 1990–2021 (%)	Percentage change in ASR, 1990–2021 (%)
Female	1 916 297.60 (1 268 797.03, 2 697 981.01)	208.00 (140.94, 286.26)	6.90 (–46.57, 60.36)	–37.28 (–67.23, –7.33)	8 312 823.95 (5 866 166.4, 11 110 101.68)	195.59 (137.73, 261.85)	49.69 (–16.71, 116.09)	–15.69 (–53.31, 21.93)
Male	1 397 831.13 (934 966.00, 1 938 797.57)	149.83 (100.17, 207.66)	1.62 (–46.83, 50.06)	–38.13 (–67.32, –8.93)	7 256 394.87 (5 059 973.03, 9 852 409.9)	172.12 (120.13, 234.02)	36.95 (–23.96, 97.86)	–22.64 (–57.28, 12.00)
LBP attributable to smoking								
Both	1 853 130.07 (1 084 580.58, 2 703 582.50)	90.79 (53.26, 131.01)	42.96 (–42.88, 128.81)	–30.69 (–71.80, 10.42)	8 823 842.71 (5 183 695.08, 13 132 647.16)	102.04 (60.03, 152.1)	30.05 (–50.39, 110.49)	–33.40 (–74.59, 7.78)
Female	294 549.96 (158 883.60, 472 835.86)	27.02 (14.46, 43.12)	30.81 (–65.41, 127.02)	–45.41 (–85.24, –5.59)	2 877 210.51 (1 637 671.09, 4 408 486.19)	65.13 (37.10, 100.11)	21.23 (–59.04, 101.50)	–38.52 (–79.38, 2.35)
Male	1 558 580.12 (931 831.26, 2 265 680.10)	154.47 (92.95, 224.17)	45.52 (–39.91, 130.94)	–26.11 (–68.95, 16.73)	5 946 632.19 (3 511 232.48, 8 767 360.65)	140.55 (83.36, 207.28)	34.80 (–46.52, 116.11)	–30.74 (–72.34, 0.86)
LBP attributable to high body mass index								
Both	1 062 017.57 (109 970.69, 2 225 148.9)	52.70 (5.41, 110.10)	333.10 (–253.57, 919.76)	116.52 (–175.4, 408.43)	8 363 759.33 (840 306.54, 17 424 821.68)	97.66 (9.78, 204.00)	170.97 (–202.94, 544.88)	39.08 (–152.38, 230.53)
Female	703 298.40 (73 130.67, 1 478 284.51)	67.51 (6.96, 142.32)	354.35 (–262.17, 970.87)	113.64 (–175.94, 403.21)	5 541 374.25 (556 565.96, 11 636 895.13)	126.29 (12.63, 266.01)	167.40 (–203.88, 538.67)	37.26 (–153.24, 227.75)
Male	358 719.17 (36 840.02, 745 322.46)	37.45 (3.81, 77.55)	296.71 (–242.07, 835.49)	118.75 (–176.56, 414.06)	2 822 385.08 (283 740.58, 5 786 405.47)	67.56 (6.78, 138.87)	178.28 (–200.90, 557.45)	45.07 (–151.87, 242.01)

Notes: ASR: age-standardized rate; LBP: low back pain; YLDs: years lived with disability.

high BMI. This trend was evident in both men and women, but men experienced more significant shifts, with greater declines in ASYR linked to occupa-

tional ergonomic issues and more notable increases in ASYR associated with high BMI compared to women (Table 2).

Table 2 Trends in age-standardized YLD rates of low back pain and its associated risk factors in China from 1990 to 2021, by joinpoint regression

Risk factors	Both sexes			Male			Female		
	Segment	Period	APC (95%)	Segment	Period	APC (95%)	Segment	Period	APC (95%)
All estimated risk factors	1	1990–1994	–3.47 (–3.60, –3.34)	1	1990–1993	–2.73 (–2.80, –2.66)	1	1990–1994	–4.62 (–4.78, –4.46)
	2	1994–2002	–0.58 (–0.63, –0.52)	2	1993–1996	–1.05 (–1.20, –0.91)	2	1994–2002	–0.38 (–0.45, –0.32)
	3	2002–2010	–1.30 (–1.35, –1.24)	3	1996–2001	–0.74 (–0.78, –0.69)	3	2002–2010	–1.37 (–1.43, –0.32)
	4	2010–2014	–0.74 (–0.80, –0.68)	4	2001–2010	–1.17 (–1.18, –1.15)	4	2010–2014	–0.59 (–1.13, –0.05)
	5	2014–2021	0.13 (0.07, 0.19)	5	2010–2015	–0.66 (–0.71, –0.61)	5	2014–2021	0.39 (0.31, 0.46)
	6	NA	NA	6	2015–2018	0.08 (–0.08, 0.23)	6	NA	NA
	7	NA	NA	7	2018–2021	–0.30 (–0.38, –0.22)	7	NA	NA
	AAPC	1990–2021	–1.00 (–1.04, –0.96)	AAPC	1990–2021	–0.95 (–0.98, –0.93)	AAPC	1990–2021	–1.08 (–1.13, –1.01)
Occupational ergonomic factors	1	1990–1993	–4.37 (–4.67, –4.08)	1	1990–1993	–2.89 (–3.10, –2.68)	1	1990–1994	–4.78 (–5.01, –4.55)
	2	1993–1996	–1.30 (–1.91, –0.69)	2	1993–2000	–1.01 (–1.08, –0.94)	2	1994–2003	–0.53 (–0.61, –0.45)
	3	1996–2000	–0.54 (–0.85, –0.23)	3	2000–2004	–1.63 (–1.84, –1.41)	3	2003–2011	–2.11 (–2.21, –2.02)
	4	2000–2004	–1.32 (–1.63, –1.01)	4	2004–2011	–2.55 (–2.62, –2.47)	4	2011–2014	–1.22 (–1.97, –0.47)
	5	2004–2011	–2.30 (–2.40, –2.20)	5	2011–2015	–1.38 (–1.61, –1.15)	5	2014–2021	–0.10 (–0.20, 0.00)
	6	2011–2014	–1.34 (–1.96, –0.72)	6	2015–2018	–0.01 (–0.50, 0.48)	6	NA	NA
	7	2014–2021	–0.23 (–0.32, –0.15)	7	2018–2021	–0.63 (–0.87, –0.39)	7	NA	NA
	AAPC	1990–2021	–1.50 (–1.60, –1.40)	AAPC	1990–2021	–1.54 (–1.60, –1.47)	AAPC	1990–2021	–1.47 (–1.55, –1.38)

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Risk factors	Both sexes			Male			Female		
	Segment	Period	APC (95%)	Segment	Period	APC (95%)	Segment	Period	APC (95%)
Smoking	1	1990-1993	-3.05 (-3.23, -2.87)	1	1990-1993	-2.80 (-2.96, -2.64)	1	1990-1993	-4.13 (-4.61, -3.64)
	2	1993-1999	-1.51 (-1.59, -1.43)	2	1993-1999	-1.32 (-1.39, -1.24)	2	1993-2005	-2.25 (-2.32, -2.19)
	3	1999-2005	-1.27 (-1.35, -1.19)	3	1999-2005	-0.97 (-1.04, -0.89)	3	2005-2011	-0.82 (-1.04, -0.60)
	4	2005-2012	-0.44 (-0.50, -0.38)	4	2005-2013	-0.28 (-0.33, -0.24)	4	2011-2021	-1.54 (-1.62, -1.46)
	5	2012-2021	-0.84 (-0.87, -0.81)	5	2013-2021	-0.72 (-0.76, -0.69)	5	NA	NA
	AAPC	1990-2021	-1.18 (-1.21, -1.15)	AAPC	1990-2021	-0.97 (-1.00, -0.95)	AAPC	1990-2021	-1.93 (-2.00, -1.86)
High body mass index	1	1990-1993	-2.26 (-2.61, -1.90)	1	1990-1992	-0.77 (-1.00, -0.53)	1	1990-1994	-2.86 (-3.11, -2.61)
	2	1993-1996	1.17 (0.43, 1.91)	2	1992-1995	0.86 (0.62, 1.10)	2	1994-2007	2.85 (2.80, 2.90)
	3	1996-2008	2.91 (2.86, 2.96)	3	1995-2005	2.66 (2.64, 2.69)	3	2007-2021	3.77 (3.73, 3.81)
	4	2008-2021	3.65 (3.61, 3.69)	4	2005-2015	3.13 (3.11, 3.16)	4	NA	NA
	5	NA	NA	5	2015-2019	3.67 (3.55, 3.80)	5	NA	NA
	6	NA	NA	6	2019-2021	2.84 (2.59, 3.09)	6	NA	NA
	AAPC	1990-2021	2.53 (2.46, 2.62)	AAPC	1990-2021	2.55 (2.52, 2.59)	AAPC	1990-2021	2.51 (2.46, 2.55)

Notes: AAPC: average annual percent change; APC: annual percentage change; NA: not available; YLD: years lived with a disability.

3.3. Characteristics of included trials in the meta-analysis of TCM for LBP

A comprehensive search yielded 62 442 records. After removing duplicates, 40 384 records were screened by title and abstract, and 511 full-text articles were assessed for eligibility (Appendix 4). Studies excluded at full text are listed in Appendix 5. Ultimately, 137 RCTs (11 936 individuals with non-specific LBP) were included (Figure 3).

Table 3 summarizes the characteristics of the 137 included studies, categorized by outcome (Appendix 6). Publication dates ranged from 2001 to 2025; the majority of the studies were non-commercially funded, and a few had unclear funding. Physiotherapy care was the most frequently studied comparator across outcomes. Mean age, sample size, and pain duration were similar across the physical function and pain intensity studies.

The result of the risk-of-bias assessment for physical function and pain intensity in the included studies (Appendix 7). Regarding pain intensity, among 86 unique studies incorporated into the meta-analysis, 81 (94.10%) were found to have some concerns, while 5³³⁻³⁷ (5.80%) were classified as having a high risk of bias. For physical function, out of the 66 unique studies, 62 (93.90%) were identified as having some concerns about bias, and 4^{34,36-38} (6.10%) were considered to have a high risk of bias. Across outcomes, the main bias concerns were deviations from intended interventions, outcome measurement, and selection of reported results.

3.4. TCM interventions for primary outcomes

Twenty-eight studies (2129 participants) evaluated acupuncture for LBP (Figures 4 and 5). For physical function, acupuncture plus WM versus WM alone showed low heterogeneity ($I^2 = 0\%$, $P > 0.5$) and an SMD = -0.96 (-1.29, -0.63) (Figure 5A). Versus physiotherapy care, acupuncture showed no significant difference in pain or disability (Figures 4B and 5B). In a treatment-duration subgroup analysis of acupuncture plus physiotherapy care versus physiotherapy care alone, the 2-to-4-week subgroup showed significant pain relief (SMD = -1.38, 95% CI [-1.65, -1.11], $P < 0.001$, $I^2 = 8\%$); acupuncture plus physiotherapy care significantly improved physical function versus control in all subgroups. For pain, funnel-plot asymmetry suggested publication bias (Egger's test, coefficient = -15.98, $P < 0.001$), and the trim-and-fill method imputed four missing studies (Appendix 8); the adjusted pooled estimate remained robust and favored acupuncture (SMD = -1.01, 95% CI [-1.58, -0.44]). For physical function, funnel-plot asymmetry reflected a small-study effect; removing the small study ($n = 37$) eliminated the bias

(coefficient = -8.26; $P = 0.054$), reduced heterogeneity ($I^2 = 73\%$, $P < 0.001$), and gave a pooled SMD = -1.03 (-1.30, -0.76) (Appendix 8). At short-term follow-up, the between-group difference was significant ($P < 0.001$), with significant heterogeneity ($I^2 = 88\%$, $P < 0.001$) (Appendix 9).

Two studies ($n = 190$) found acupressure more effective than physiotherapy care for LBP pain immediately post-intervention (SMD = -0.87, 95% CI [-1.17, -0.57]) (Appendix 9). Four studies of tuina ($n = 452$) comparing tuina plus PC with WM showed low heterogeneity ($I^2 = 0\%$, $P > 0.5$), with a pooled SMD = -0.96 (-1.28, -0.63) for pain (Appendix 9) and -1.39 (-1.74, -1.05) for disability (Appendix 9). Five studies ($n = 392$) assessed cupping. Versus WM, two studies pooled to an SMD = -1.32 (95% CI [-2.08, -0.56], $I^2 = 71\%$) for pain intensity (Appendix 9). For cupping plus physiotherapy care versus physiotherapy care alone, three studies³⁹⁻⁴¹ pooled to -1.03 (95% CI [-1.51, -0.56], $I^2 = 71\%$) for pain intensity (Appendix 9) and -1.51 (95% CI [-2.45, -0.56], $I^2 = 91\%$) for physical function (Appendix 9).

Four RCTs^{35,42-44} ($n = 164$) evaluated Tai Chi (Appendix 9). Among studies comparing Tai Chi with physiotherapy care or NI, low heterogeneity was observed ($I^2 = 0\%$, $P > 0.5$). Tai Chi was most effective, with a mean pain reduction of 1.03 points (Appendix 9) and a mean improvement of 1.84 points in physical function (Appendix 9). Fourteen studies ($n = 1089$) evaluated Chinese herbal medicine for LBP. It showed no effect on pain intensity (SMD = -0.69, 95% CI [-1.47, 0.08], $P = 0.08$, $I^2 = 93\%$) compared to WM (Appendix 9). Chinese herbal medicine combined with physiotherapy care (SMD = -1.66, 95% CI [-2.27, -1.06], $I^2 = 83\%$) (Appendix 9) or with physiotherapy care plus WM (SMD = -1.20, 95% CI [-1.69, -0.71], $I^2 = 63\%$) (Appendix 9) improved physical function versus control. Six RCTs evaluated moxibustion for LBP, with pooled SMDs of -1.75 (-2.47, -1.03) for pain (Appendix 9) and -1.69 (-2.43, -0.94) for physical function (Appendix 9).

Three studies with 317 participants evaluated a combined intervention of Chinese herbal medicine, acupuncture, and moxibustion (Appendix 9), with a significant effect favoring it for pain relief (SMD = -1.13, 95% CI [-1.37, -0.89], $P < 0.001$, $I^2 = 0\%$). Twenty studies ($n = 1704$) evaluated acupuncture plus moxibustion. For acupuncture and moxibustion plus physiotherapy care versus physiotherapy care alone, nine studies ($n = 778$) reporting pain intensity were pooled for analysis, with an SMD = -1.47 (95% CI [-1.83, -1.11], $P < 0.001$, $I^2 = 80\%$) (Appendix 9). Compared with physiotherapy care, acupuncture plus moxibustion demonstrated significant treatment effects on both physical function and pain intensity (Appendix 9). Two RCTs^{45,46} ($n = 106$) showed no significant effect of Baduanjin over physiotherapy care (pain

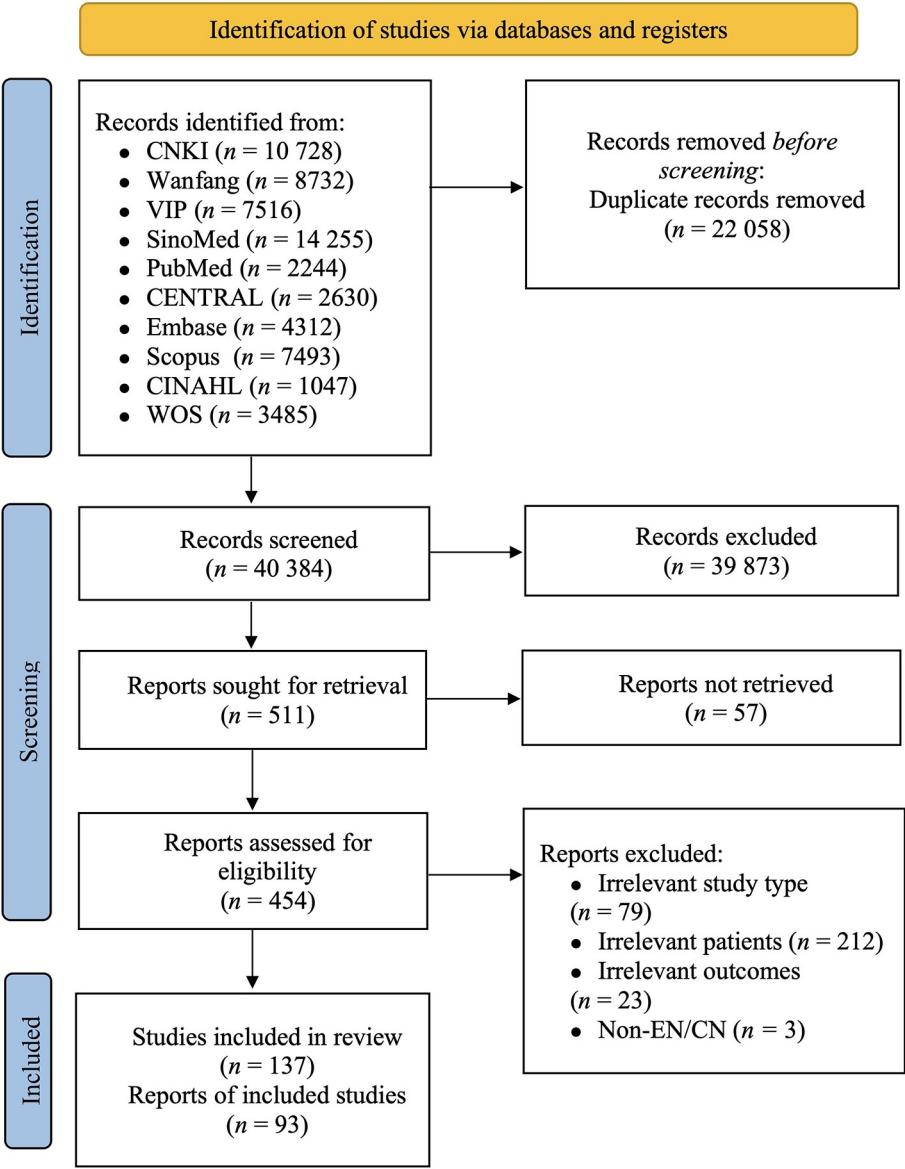


Figure 3 Flow of trials through the review

Notes: CENTRAL: Cochrane Central Register of Controlled Trials; CINAHL: Cumulative Index to Nursing and Allied Health Literature; CNKI: China National Knowledge Infrastructure; Non-EN/CN: non-English/Chinese; VIP: Chinese Scientific Journal Database; WOS: Web of Science.

Table 3 General characteristics of all included studies

Characteristics	Primary outcomes		Secondary outcomes		
	Physical function (n = 112)	Pain intensity (n = 135)	Health-related quality of life (n = 15)	TCM syndrome scores (n = 13)	Sleep quality (n = 5)
Total number of unique studies included	112	135	15	13	5
Publication year					
2001–2005	2	2	0	0	0
2006–2010	3	4	1	0	1
2011–2015	6	8	0	0	0
2016–2020	28	41	4	3	1
2021–2025	73	80	10	10	3
Funding					
None	2	3	0	0	1

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Characteristics	Primary outcomes		Secondary outcomes		
	Physical function (<i>n</i> = 112)	Pain intensity (<i>n</i> = 135)	Health-related quality of life (<i>n</i> = 15)	TCM syndrome scores (<i>n</i> = 13)	Sleep quality (<i>n</i> = 5)
Non-commercial	61	68	5	6	3
Commercial	0	0	0	0	0
Unclear	49	64	10	7	1
No. of studies containing the following treatment nodes					
Acupuncture	17	17	0	0	1
Acupressure	1	1	0	0	0
Tuina	2	2	0	0	0
Cupping	2	3	1	1	0
Tai Chi	1	3	0	0	0
Chinese herbal medicine	8	9	0	1	0
Chinese manipulation	2	2	1	0	1
Moxibustion	5	7	0	1	1
Baduanjin	4	4	0	1	0
Comprehensive nursing of TCM	1	1	0	0	0
Combined TCM therapy	16	18	3	1	1
Acupuncture + WM	4	5	1	0	0
Acupuncture + PC	18	18	1	1	0
Acupressure + PC	0	1	0	0	0
Tuina + PC	3	3	0	0	0
Cupping + PC	6	6	1	0	0
Chinese herbal medicine + PC	9	11	3	2	0
Chinese herbal medicine + WM	2	3	1	0	0
Chinese herbal medicine + WM + PC	1	1	0	0	0
Moxibustion + WM	0	0	0	0	0
Baduanjin + PC	1	1	0	0	0
Comprehensive nursing of TCM + UC	3	5	1	0	0
Combined TCM therapy + PC	8	9	1	0	0
Combined TCM therapy + WM	3	3	1	2	1
Comprehensive therapy + WM + PC	2	2	0	0	0
PC	53	57	6	4	2
WM	33	41	5	5	1
AI	0	0	0	0	0
UC	13	15	2	2	1
NI	3	7	0	0	0
PC + WM	8	8	0	0	0
Others	6	8	1	2	0
Studies with durations of follow-up					
Post-intervention	112	135	15	13	5
Short term	19	21	1	2	1
Intermediate term	4	5	0	0	0
Long term	1	1	0	0	0
Range of mean age (years), <i>n</i>	19.59-81.14, 110	19.59-81.14, 132	20.18-68.36, 13	27.65-81.14, 13	38.11-73.2, 5
Range of males (%), <i>n</i>	0-100, 110	0-100, 132	16.67-62.50, 13	40-60, 12	16.67-62.22, 5
Duration of pain (months), <i>n</i>	0.03-300.00, 98	0.03-300.00, 116	3.9-71.4, 11	2.45-47.16, 10	5.24-19.29, 4

Notes: AI: advice interventions; NI: no intervention; PC: physiotherapy care; TCM: traditional Chinese medicine; UC: usual care; WM: Western medicine.

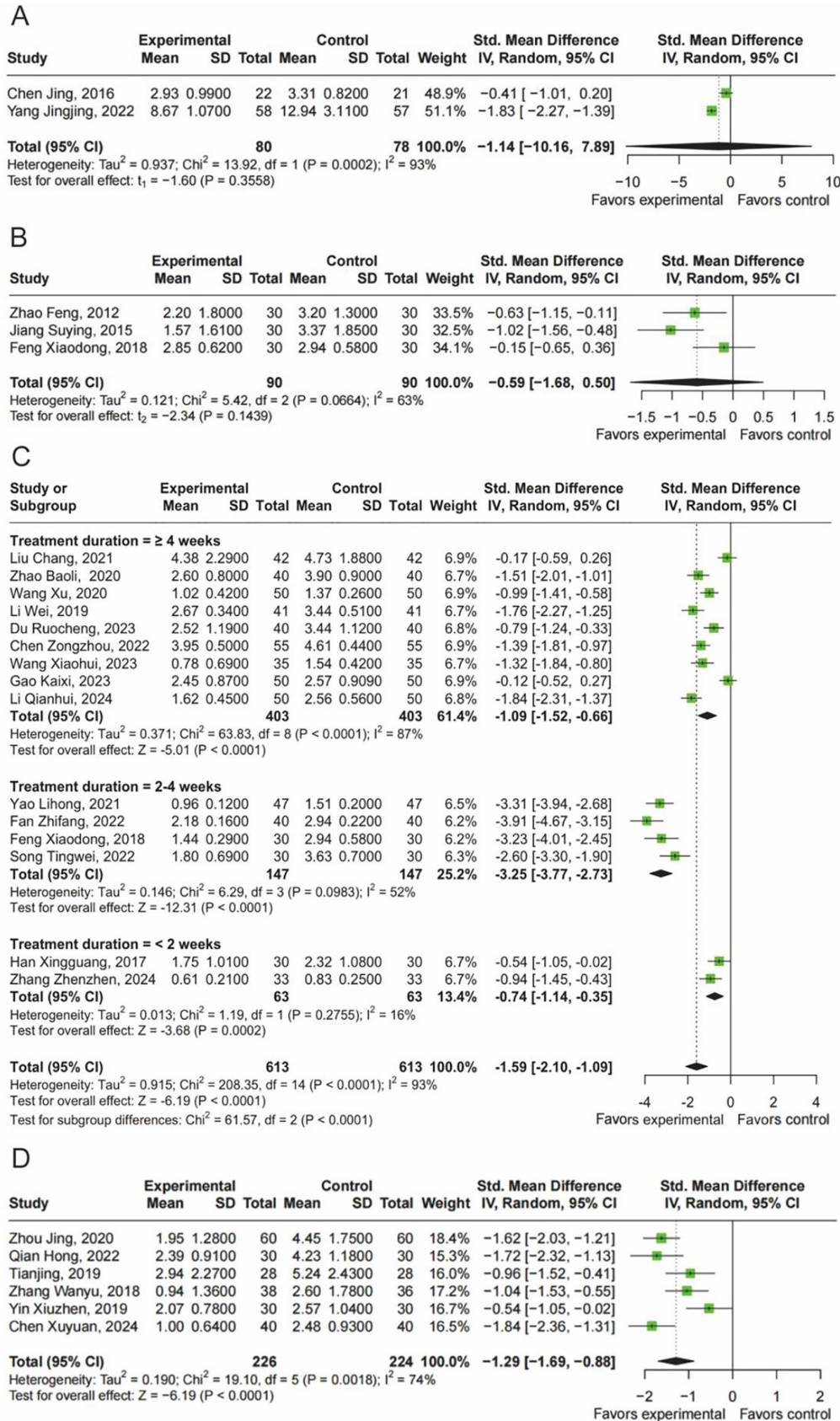


Figure 4 Forest plots of pain intensity for acupuncture: (A) acupuncture plus WM versus WM; (B) acupuncture versus PC; (C) acupuncture plus PC versus PC; (D) acupuncture versus WM

Notes: CI: confidence interval; IV: inverse variance; PC: physiotherapy care; SD: standard deviation; WM: Western medicine.

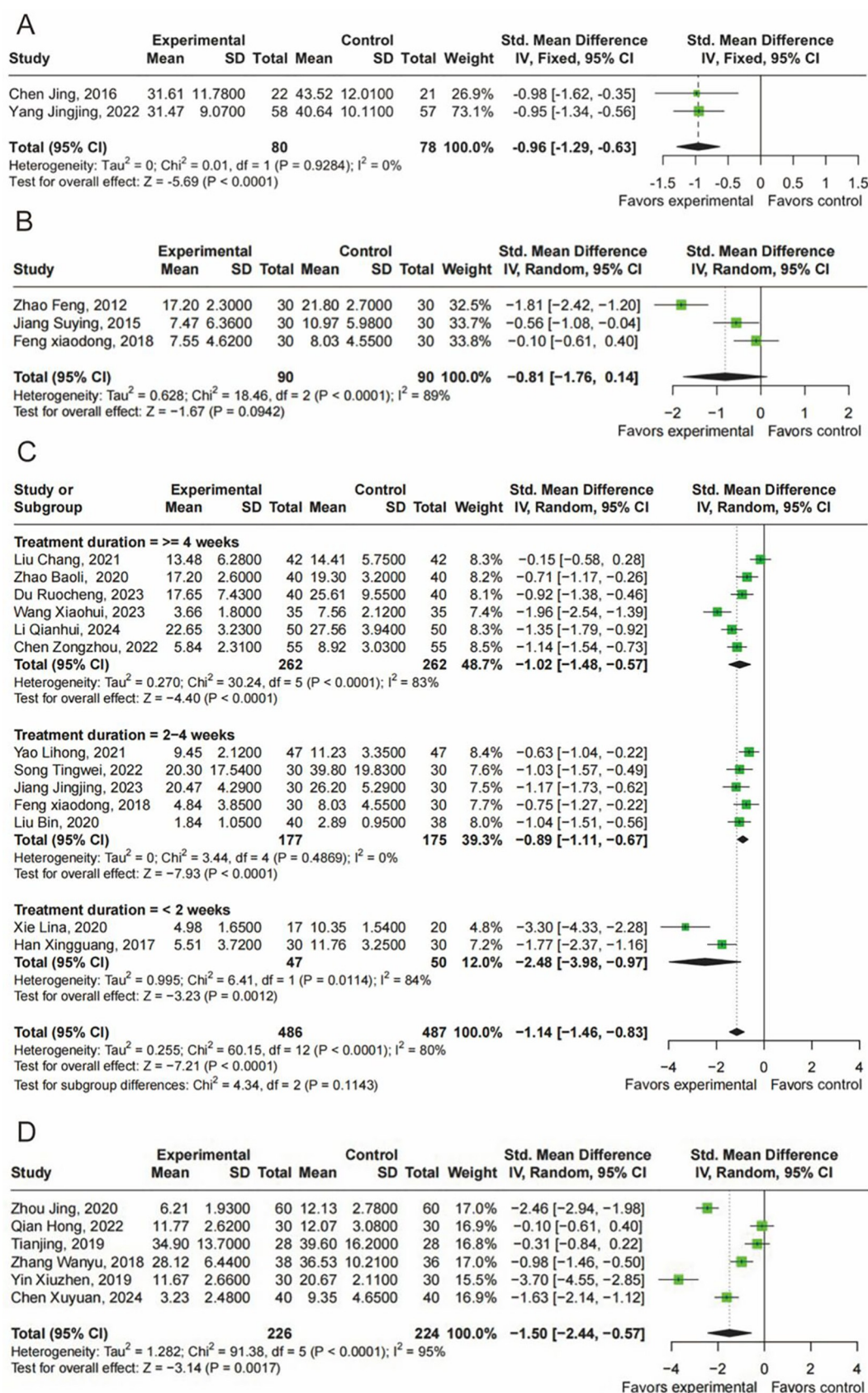


Figure 5 Forest plots of physical function for acupuncture: (A) acupuncture plus WM versus WM; (B) acupuncture versus PC; (C) acupuncture plus PC versus PC; (D) acupuncture versus WM

Notes: CI: confidence interval; IV: inverse variance; PC: physiotherapy care; SD: standard deviation; WM: Western medicine.

intensity: SMD = -1.45, 95% CI [-4.75, 1.84], $P = 0.38$; physical function: SMD = -2.38, 95% CI [-4.91, 0.15], $P = 0.06$) (Appendix 9). Two studies ($n = 180$) showed a significant difference between TCM wet compress therapy plus physiotherapy care and physiotherapy care alone, with significant heterogeneity ($I^2 = 88\%$, $P < 0.01$) (Appendix 9).

3.5. TCM interventions for secondary outcomes

Overall, 21 trials reported adverse events ($n = 2004$), with no serious adverse events in either arm (Appendix 10). Most adverse reactions were mild to moderate and resolved with symptomatic treatment; although some patients withdrew because of mild reactions, the findings raise no significant safety concerns. For the other secondary outcomes (QoL, sleep quality, and TCM syndrome scores), results were inconclusive and mixed (Appendix 10).

3.6. Sensitivity analyses and quality of evidence

All post hoc sensitivity analyses left the original findings substantially unchanged (Appendix 11). Certainty of the evidence, assessed by GRADE, was generally low to moderate, downgraded mainly for significant heterogeneity and small sample sizes (Appendix 12).

4. Discussion

This study comprehensively analyzed the LBP burden and its risk factors in China from 1990 to 2021 and systematically assessed TCM interventions for LBP in the Chinese population. China had the highest incidence, prevalence, and YLDs of LBP among G20 countries in 2021, and multiple TCM interventions, administered alone (acupuncture, acupressure, cupping, Tai Chi, or acupuncture plus moxibustion) or with physiotherapy care, appeared more effective than conventional therapies (physiotherapy care or WM) in relieving pain and improving physical function post-intervention. Certainty was mostly low or moderate, and no serious adverse events were reported during the course of the study.

4.1. LBP burden in China and the efficacy of TCM

The age-standardized prevalence of LBP in China was 5.34% (4.66% to 5.98%), which was lower than the global prevalence of 7.46% (6.58% to 8.32%). The EAPC indicated declining age-standardized incidence, prevalence, and YLD rates of LBP in China from 1990 to 2021. Several factors may have contributed, including greater health awareness, enhanced public health initiatives, standardized pain management, and effective risk-factor prevention.¹⁷ Despite the falling ASR, in 2021 China had the highest numbers of new LBP cases and patients among the G20 countries (43.37 million and 100.09 million, respectively), likely reflecting its massive population and accelerated aging. LBP incidence, prevalence, and YLDs increase with age, peaking around 85 years, consistent with other studies.^{1,47} In TCM, LBP arises from kidney and essence deficiency, qi-blood depletion, and meridian blockage from qi stagnation, blood stasis, or trauma, which disrupts circulation and triggers pain. Aging depletes kidney qi and qi-blood and lowers resistance to external pathogens, worsening meridian obstruction and increasing susceptibility to pain.⁴⁸ Given the high prevalence of LBP among older adults, evidence-based management recommendations are essential to reduce the burden. The WHO Integrated Care for Older People approach promotes healthy aging through personalized exercise and the integration of medical, rehabilitation, and community resources in primary care.⁶

In this study, occupational ergonomic exposure remained the primary modifiable driver of LBP burden in China, and reductions in ergonomic-related cases mainly drove the declining ASR for LBP. Prior studies show that prolonged working hours, non-neutral postures, forceful exertions, and repetitive activities increase LBP risk.²⁴ China once experienced a significant number of patients with LBP due to its labor-intensive manufacturing industry.⁴⁹ Mandatory ergonomic-equipment policies, widespread mechanization

and automation, and measures such as work-break regulations and lumbar-protection training have improved the occupational ergonomic environment on multiple fronts.⁵⁰ Smoking, another major risk factor, particularly affects men by accelerating disc degeneration, inducing chronic inflammation, and worsening pain and dysfunction.⁵¹ Interestingly, LBP burden linked to high BMI shows a significant upward trend, with a potentially stronger impact observed in females. Obesity increases lumbar mechanical load, and pro-inflammatory cytokines from adipose tissue exacerbate intervertebral disc degeneration.⁵² Females are more susceptible due to pelvic anatomical, hormonal, and muscular differences.⁵³ Given the rising LBP burden and shifting risk factors, accessible, guideline-recommended non-pharmacological strategies are urgently needed. Importantly, specific TCM modalities may both relieve LBP symptoms and address these GBD-identified risk factors. For ergonomic-related LBP, tuina relieves musculoskeletal tension, reduces adhesions, and restores joint mobility in chronic non-specific LBP,⁵⁴ and Tai Chi, through its deliberate movements and focus on postural alignment, has demonstrated significant reductions in pain and disability in this population.⁵⁵ For smoking-related LBP, acupuncture has shown potential for smoking cessation through modulation of endogenous opioids and dopaminergic pathways, which may indirectly attenuate smoking-induced intervertebral disc degeneration and systemic inflammation.^{56–58} For high-BMI-related LBP, while direct evidence in BMI-stratified LBP populations remains limited, Chinese herbal medicine has demonstrated efficacy in reducing body weight and BMI in systematic reviews of RCTs,⁵⁹ and Tai Chi, as a low-impact mind-body exercise, may offer additional benefit by improving core strength and metabolic function in patients with obesity-related musculoskeletal pain.⁵⁵ Given the high costs of surgery and the addiction, overdose, and mortality risks of opioids, TCM has become an increasingly popular alternative for pain management across healthcare settings.¹

Compared with baseline, most TCM interventions in this review improved pain intensity and physical function and may also mitigate LBP-related risk factors, suggesting value both as symptomatic treatments and as part of a broader risk-reduction strategy. Specifically, acupuncture plus physiotherapy care and acupressure (both moderate-quality evidence) significantly reduced pain and disability versus physiotherapy care alone post-intervention, consistent with previous systematic reviews.^{60,61} Moreover, acupuncture plus moxibustion substantially reduced pain and improved function versus physiotherapy care alone (moderate-to-high quality) or WM alone (low quality). The high heterogeneity observed reflects variation across acupuncture treatments in manipulation, acupoints, and treatment duration and frequency. Such heterogeneity was not limited to acupuncture, with considerable variance also in Chinese herbal medicine versus WM for pain ($I^2 = 93\%$) and cupping plus physiotherapy care versus physiotherapy care for physical function ($I^2 = 91\%$). This likely arose both clinically, from differences in herbal formulae, acupoint selection, needling technique, cupping method, frequency, and duration, and methodologically, from absent blinding, varied control groups, and inconsistent outcome measures. Subgroup analysis by treatment duration (≥ 4 weeks, 2–4 weeks, and < 2 weeks) partially addressed this: for acupuncture plus physiotherapy care versus physiotherapy care, the 2–4 week subgroup showed substantially reduced heterogeneity for pain ($I^2 = 8\%$), indicating treatment duration is a meaningful source of variance; for comparisons with very high heterogeneity ($I^2 > 75\%$), however, duration alone did not explain the residual variance, which likely reflects genuine clinical diversity in TCM protocols. A review by Geesung reported that the acupoints with the highest average effect sizes were Pishu (BL20), Yaoyangguan (GV3), Huantiao (GB30), Yanglingquan (GB34), and Dachangshu (BL25).⁶¹ Another review revealed that warm needle acupuncture, electrical warm needling, and treatments based on the meridian-sinew theory are primarily recommended.⁶² Hence, developing a standardized acupuncture protocol is essential. Notably, acupuncture's benefits extend to mitigating smoking through endogenous opioid modulation.⁵⁶ Several systematic reviews have demonstrated that transdermal acupuncture via needles and auricular acupressure are associat-

ed with higher smoking cessation rates.^{57,58} The Standards Working Committee of the World Federation of Acupuncture-Moxibustion Societies (WFAS) has issued its first clinical practice guideline on acupuncture and moxibustion for non-specific LBP, offering evidence-based recommendations for practitioners globally.⁶³

Chinese herbal medicine plus physiotherapy care (moderate-quality evidence) reduced LBP more than physiotherapy care alone post-intervention. Versus WM (very-low-quality evidence), no immediate effect on pain was observed post-intervention, but a significant effect emerged at short-term follow-up. WM may provide rapid symptomatic relief, but long-term use can cause drug resistance or adverse effects.¹⁰ A stepwise plan combining short-term WM analgesia with medium- to long-term Chinese herbal medicine may improve compliance. Tuina plus physiotherapy care (moderate-quality evidence) and cupping plus physiotherapy care (low-quality evidence) significantly relieved pain and disability versus WM and physiotherapy care alone, respectively. However, tuina plus physiotherapy care did not improve physical function over physiotherapy care alone, possibly because functional gains require longer-term treatment whereas short-term tuina mainly relieves symptoms.⁵⁴ As specific types of mind-body interventions, Baduanjin did not relieve pain or improve function in adults with LBP, whereas Tai Chi was significantly effective versus physiotherapy care and may address several risk factors at once (e.g., improving core strength, flexibility, stress, and movement confidence). However, a prior systematic review suggested Baduanjin slightly improved pain relief versus general exercise.⁶⁴ Tuina and Tai Chi effectively relieve LBP from occupational ergonomic factors such as prolonged poor posture and repetitive strain. Tuina targets muscle tension, adhesions, and restricted joint mobility from static or repetitive work postures.⁶⁵ Tai Chi, with its deliberate movements and focus on alignment, enhances core strength, dynamic balance, and body awareness.

4.2. Limitations

This study has some limitations. First, the limited number of studies for certain TCM interventions reduced statistical power and may inflate effect estimates, warranting cautious interpretation. Second, trials focused mainly on post-intervention outcomes, with little attention to intermediate- and long-term follow-up (especially beyond six months), limiting insight into the long-term efficacy of TCM. Third, the included studies had methodological flaws that may compromise reliability; the lack of blinding of participants and therapists may have exaggerated intervention effects.⁶⁶ Fourth, because GBD data are modeled rather than directly measured, annual variation and model data quality can affect findings, as noted elsewhere.¹ Fifth, this study does not include predictive modeling of future LBP burden trends, nor were risk-factor-stratified subgroup analyses feasible, as the majority of included RCTs were not designed to stratify participants by GBD-identified risk factors. Sixth, several meta-analyses showed considerable heterogeneity, likely reflecting genuine clinical variability in TCM protocols, so these pooled estimates should be interpreted cautiously as hypothesis-generating. Despite these limitations, this is the first study to comprehensively analyze LBP burden in China and provide robust evidence supporting TCM interventions for Chinese patients with LBP.

4.3. Implications for research and practice

Despite declining ASRs from 1990 to 2021, China still has the highest incidence, prevalence, and YLDs of LBP among G20 nations, driven by its vast population and rapid aging. To alleviate this burden, China should prioritize nationwide, comprehensive LBP prevention that integrates policy-driven primary care interventions (e.g., workplace ergonomic improvements, health education with exercise, reduced occupational sedentariness, and physical activity).¹⁰ The GBD database highlights the magnitude of the LBP problem in China, while the TCM meta-analysis offers potential solutions. TCM interventions (e.g., acupuncture, acupressure, cupping, Tai Chi, and combined acupuncture-moxibustion) have demonstrated promising efficacy in managing LBP and reducing risk factors. These findings lend support to the clinical

adoption of TCM as a safe alternative for pain management.⁶⁷ Clinical pathways and guidelines should clarify the recommendation levels of TCM interventions for LBP patients, categorized by risk factors, age, and sex. However, heterogeneous TCM protocols (e.g., acupoint selection, treatment duration/frequency) and inconsistent evidence for some therapies (e.g., Baduanjin, moxibustion) underscore the urgent need for standardized, replicable regimens. Because evaluation data on psychological, lifestyle, and social factors were lacking, we did not discuss these here. Future research should therefore assess the long-term efficacy, cost-effectiveness, and psychosocial/lifestyle impacts of TCM and conduct rigorous, large-scale RCTs in diverse cohorts using standardized protocols and extended follow-up to address evidence gaps in understudied modalities.

The EAPC trends support qualitative projections of China's future LBP burden. The sustained decline in age-standardized rates suggests that, if current policies are maintained, rates may continue to fall modestly in the near term. Caution is warranted, however, given rapid aging: as the number of older adults grows, the total LBP burden will likely remain substantial or rise, especially given the sharply increasing burden from high BMI.⁶⁸ Integrating effective TCM interventions into routine care could help mitigate this rise. Nonetheless, formally quantifying future burden trajectories, with and without intervention, is an important next step that would strengthen the evidence base for health-policy planning and resource allocation.

5. Conclusion

China reported the highest numbers of new LBP cases and prevalence among the G20 countries in 2021, and certain TCM interventions (e.g., acupuncture, acupressure, cupping) showed potential efficacy in reducing disability and pain. YLDs due to LBP were linked to risk factors that rise with age, peaking around 85 years, and were higher in females than males. High-quality evidence to guide clinical decision-making on TCM for LBP remains limited. Given the substantial burden shown by the GBD data and the potential of TCM indicated by the meta-analysis, China urgently needs to prioritize LBP, and large-scale, high-quality, long-term RCTs are essential, especially in older and female populations.

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Data Availability

Data will be made available by the corresponding author upon reasonable request.

Author Contribution Statement

Man-ci Zhou: Data curation, methodology, software, visualization, formal analysis, and writing – original draft. **Xiu-mei Wang:** Data curation, software, validation, and writing – original draft. **Jun-yan Zeng:** Data curation, methodology, visualization, and writing – review & editing. **Guo-lin Guo:** Investigation, resources, formal analysis, and writing – review & editing. **Mitchell Levine:** Methodology, formal analysis, and writing – review & editing. **Jian Li:** Supervision and writing – review & editing. **Hong-guo Rong:** Conceptualization, supervision, project administration, funding acquisition, and writing – review & editing.

Use of AI statement

None.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this study.

Electronic Supplementary Material

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